Fire Ant Management Plan:
Little Rock Air Force Base and Camp Robinson, Arkansas

Kelly M. Loftin
Associate Professor
University of Arkansas
Fayetteville, Arkansas
Email: kloftin@uaex.edu
Phone: 479 575-3462

January 2015

TABLE OF CONTENTS

Introduction and Importance of Fire Ants ……. 1
Fire Ant Identification…….... 2
Fire Ant IPM (Integrated Pest Management)……... 4
Managing Fire Ants with Insecticides…… 5
Specialized Fire Ant Control Needs…….. 10
Fire Ant Bait Insecticides……..... 12
Contact Insecticides…… 15
Biological Control……. 17
Cultural Control……. 17
Regulatory Control…… 18
References Cited…….. 19

LIST OF FIGURES

Fig. 1. Typical fire ant colony…….. 3
Fig. 2. Array of fire ant worker sizes…….. 3
Fig. 3. Characteristics of fire ant worker head……. 4
Fig. 4. Herd GT77 Fire ant bait applicator……. 7
Fig. 5. Typical hand-held seeder…… 7
Fig. 6. Boom sprayer used to apply a liquid insecticide … 10
Fig. 7. Map of imported fire ant quarantine area……. 19

Fire Ant Management Plan: Little Rock Air Force Base and Camp Robinson, Arkansas

This fire ant management plan provides basic recommendations to manage imported fire ants at Little Rock Air Force Base and Camp Robinson, Arkansas. To maintain military readiness and mission, installation personnel are encouraged to prioritize the level of fire ant control needed to achieve the desired goal. For example, a greater level of fire ant control is needed in high-use training areas, public recreation areas and other sensitive areas such as aircraft landing sites and runways than areas not directly used to support the military mission. Imported fire ants are well established in this area of Arkansas and eradication is not possible. However, through persistence and effective methods, fire ants can be managed. Remember, not all areas of the installation will be treated the same, and prioritization of fire ant management by area of the installation is a very important component of the management plan. Long-term suppression of imported fire ants involves classical biological control. This management plan is a portion of a Department of Defense Legacy project deliverable. The overall project involved the release of decapitating phorid flies (*Pseudacteon* spp.) at both installations.

Introduction and Importance of Fire Ants

The term “Imported fire ant” is used as a collective term to designate fire ants introduced into the U.S. *Soleopsis invicta* is the red imported fire ant (RIFA); *Solenopsis richteri* is the black imported fire ant (BIFA); and the *Solenopsis invicta* X *Solenopsis richteri* hybrid is referred to as the hybrid fire ant.

Imported fire ants are extremely important pests in the southern U. S., especially when considering the wide range of sectors impacted. Lard et al. (2006) estimated the annual economic impact of IFAs in the U.S. at roughly $6.3 billion. Losses in residential households and agriculture were estimated at $3.67 billion and $428 million, respectively. Annual economic losses in southeastern states range from $1.28 million in Arkansas to $1.3 billion in Florida. Of 14 economic sectors evaluated in the Lard et al. (2006) study, the greatest losses from IFAs were residential households, electrical and communication equipment, agriculture, golf courses and schools.

Imported fire ants also negatively impact native species. Imported fire ants prefer insect and arthropod prey over crops and other vegetation. However, imported fire ants will protect (tend) some plant insects (aphids, mealybugs) which produce a sugary substance (honeydew) that the ants use as a carbohydrate source. Imported fire ants have been shown to prey on beneficial insects. For example, they will prey on a parasitic wasp that attacks the tobacco budworm. Beneficial insects such as lady beetles, hover flies and lacewings that are natural enemies of cottons aphids are eaten by imported fire ants. They are also known predators of soil-inhabiting leafcutter bees and honey bee larvae. Expansion of the red imported fire ant into a Texas biological field stations suggested a 70% loss in native ant species. Researchers in Texas (Hook and Porter 1990; Camilo and Phillips 1990) found that the red imported fire ant had a negative impact on diversity of native ant species.

The negative impact of imported fire ants is not restricted to arthropods. They may attack ground-nesting birds, newborn wildlife and livestock, and reptiles. Newly hatched or birthed wildlife such as deer, ground-nesting birds, and reptiles are more likely to be affected by imported fire ants than are adults. For example, fawns that instinctively remain motionless in their hiding places to avoid large predators are at risk of attack by fire ants. Studies have also shown that as few as 50 imported fire ant stings to a bobwhite quail chick can affect its chance for survival (Giuliano et. al. 1996). Researchers in Alabama suggest that nine reptile species have been decimated by imported fire ants (Stimac and Alves 1994). Although fire ants can sting and kill newly hatched birds and reptiles, they can also exploit weaknesses in the eggs as entry points in order to consume their contents.

Although arthropods are the primary food sources for imported fire ants, the ants also will feed directly on some crops. Studies have shown that soybean yield in fields infested with fire ants are significantly lower than in IFA-free fields. Crop losses are due to raising the header bar to avoid mounds, direct damage to young plants and roots, seed feeding, fruit or tuber damage and tending pest insects such as aphids. The list of crops affected include: soybeans, sorghum, corn, okra, blueberry and citrus. In addition, consumers that purchase fruits, berries and vegetables from you-pick-it operations and harvesters picking at commercial operations are frequently stung by IFAs during hand harvesting.

Imported fire ant mounds can also damage agricultural equipment. Depending upon the soil type present, mounds can become quite large (some > 24 inches in diameter and over a foot tall). These hardened mounds can physically damage harvesters, plows and other farm equipment.

Fire Ant Identification

Identification in the field:
Mound lacks external opening and fluffy in appearance.
Mounds range from a few inches to 24 inches in height.
Aggressive ants swarm when mound is disturbed.
Sting causes burning sensation and produces a pustule about 12 hours following being stung.
Workers are from ⅛ to ¼ inch in length.
Fire ant petiole (waist) consists of 2 nodes
Head and first antennae segment of red imported fire ants are reddish brown in color.
Antenna consists of 10 segments.

Fig. 1. Typical fire ant colony.

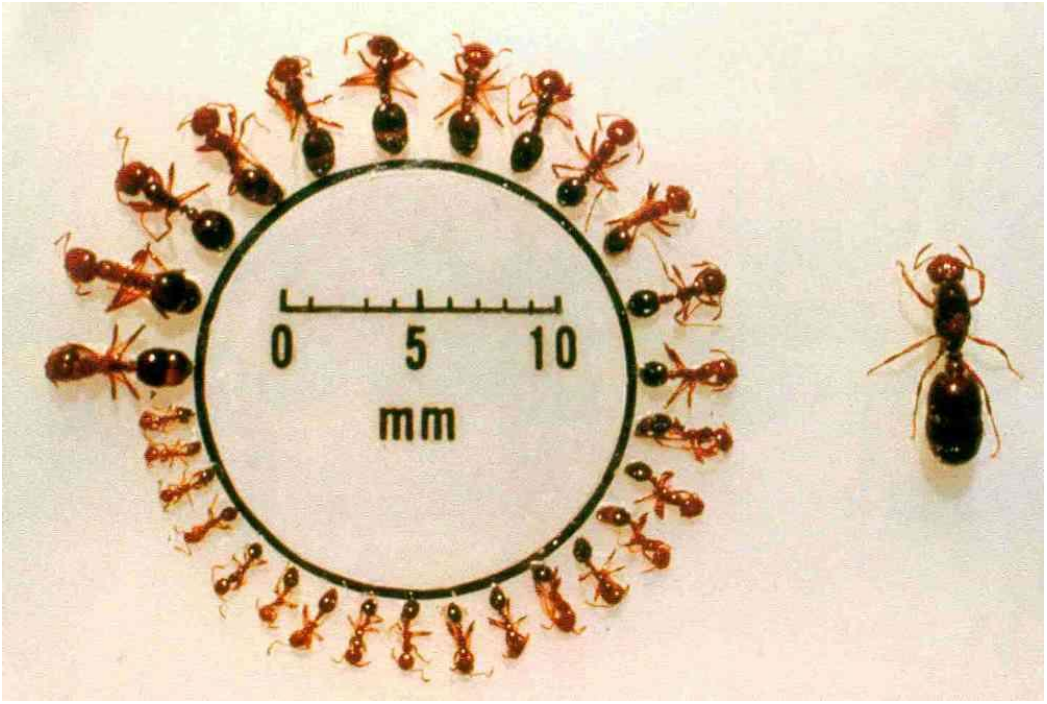

Fig. 2. Array of fire ant worker sizes. Queen is on the right. Photo by Sanford Porter USDA-ARS.

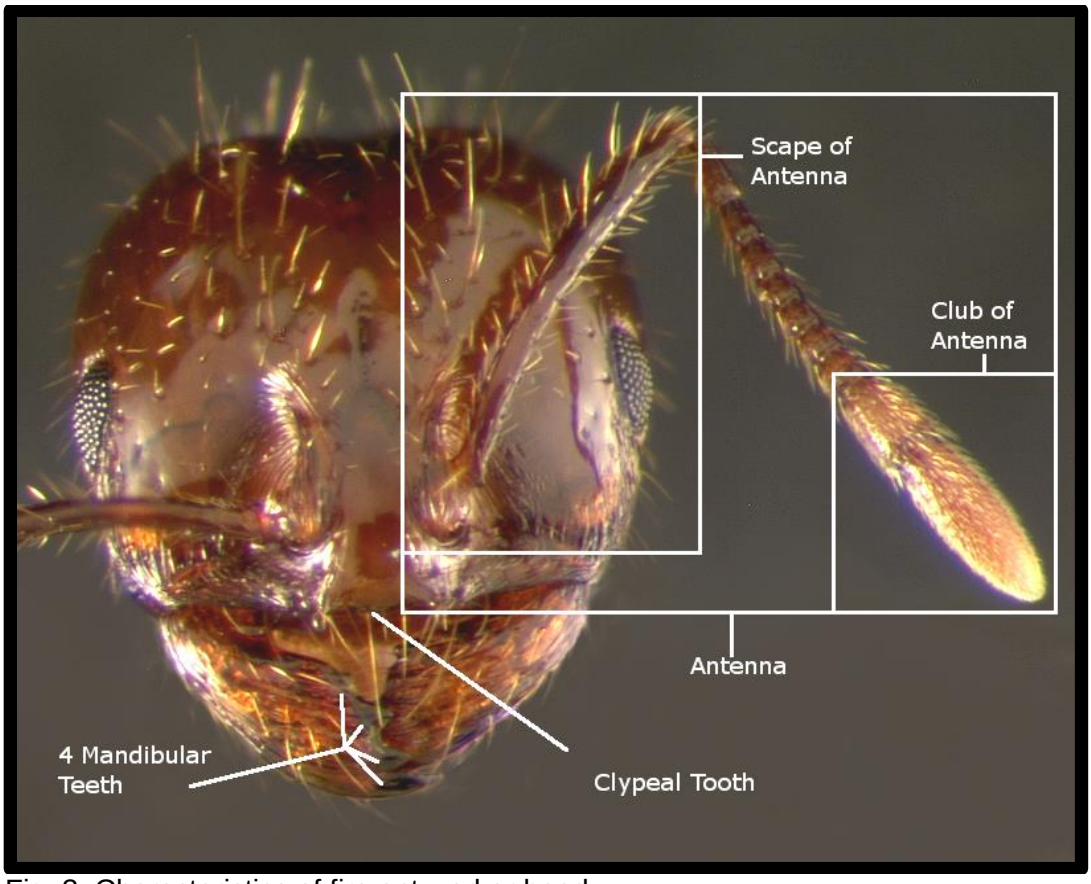

Fig. 3. Characteristics of fire ant worker head.

Fire Ant IPM (Integrated Pest Management)

Like IPM of other pests, fire ant IPM potentially involves all proven, available and safe options to manage this pest. The goal is to keep fire ant abundance below the level that causes damage for a particular area or circumstance.

The economic injury level for imported fire ants is not always as clear as with agronomic or row-crop pests. Differing circumstances demand varying levels of control. For example, the treatment threshold for a homeowner's yard with a family member highly allergic to fire ant stings, a football practice field, or commercial sod producer's field that ships sod to areas not infested with imported fire ants would be much lower than for areas not frequented by people, such as a pasture, row-crop farm or unused vacant area. Differing thresholds or desired levels of control for specific circumstances are important considerations when choosing the best-suited IPM options to manage imported fire ants.

IPM options for fire ant control evolve as new insecticides are developed, natural enemies become established and scientific research reveals new information. Below is a very brief overview of current IPM options.

Regulatory Control –This goal of imported fire ant regulatory control is to slow and prevent the artificial spread of imported fire ants from infested areas to non-infested areas. The imported fire ant quarantine is administered and enforced by the USDA Animal and Plant Health Inspection Service (APHIS) and state departments of agriculture or state plant boards.

Cultural Control – Cultural options for imported fire ant control are limited. These options include barriers and use of physical methods to control, suppress or restrict imported fire ants.

Biological Control – Biological control of imported fire ants offers the greatest potential for long-term imported fire ant suppression. Basic and applied fire ant biological control research is likely the most studied area of fire ant research.

Chemical Control – Insecticidal control of imported fire ants remains an important option for managing imported fire ants. Insecticides used in managing imported fire ants can be divided into two major types: 1) fire ant baits and 2) contact insecticides. The appropriate insecticide type and application method will depend upon the level of control desired, size of the treatment area and density of the fire ant population.

Managing Fire Ants with Insecticides

Methods for controlling imported fire ants using insecticides vary significantly and the choice usually depends upon the level and duration of control desired and the associated cost. Installation personnel (likely, the facilities unit) can prioritize the level of control needed for a specific area of the installation. The priorities may vary from: no control is needed for this area (ex. wild lands not used for training) to: a very high level of control is needed (ex. school and/or nursery playgrounds, areas where PT is conducted).

Below is an example of prioritizing fire ant control.

1. No control needed
2. Minimal control is needed and infestation is light
3. Minimal control is occasionally necessary
4. Moderate control is necessary
5. High level of control is necessary

The types of programs that broadly fit into these categories are:

1. Broadcast bait application on an as needed basis (minimal to moderate control). A successful bait application will provide a fairly high level of control (>90%) for a couple of months (Examples: seldom used areas, pastures)
2. Individual Mound Treatment. Treat individual mounds with an insecticide bait or contact insecticide labeled to control fire ants (Example: Minimal control is needed, infestation is light and area is small)

3. Two step method: Step 1) Broadcast application of fire ant bait followed by Step 2) Treat “problem colonies not controlled with the bait application with a fast-acting contact insecticide mound treatment or retreatment with bait. This two-step method would be used once or twice per year (Examples: most moderate use lawn and turf areas of an installation). This management approach will support routine military operations in areas where soldiers, personnel and family frequent on a daily basis.
4. Long-term residual control will eliminate many species of ants in the treatment area and reduces re-invasion while the contact insecticide remains active. Products are more expensive with this type of control and pose greater environmental impact than the methods listed above. Often, commercial applicators use this method. This control method involves the broadcast application of a contact insecticide such as bifenthrin or fipronil. In some situations it will be preceded with a broadcast application of fire ant bait. (Examples: High level of control is needed; school playgrounds, high use areas of parks, shooting ranges, and in some extreme cases areas near airplane runways). This management approach supports direct military training operations where are likely to encounter fire ants and are subject to fire ant stings while training; and areas where sensitive and essential electrical equipment may be located (runway lighting, automatic gates and etc.).

1. Broadcast Bait Application Only as Needed. Once or twice per year, usually in spring and fall, broadcast a bait-formulated insecticide as directed on the label. Most conventional baits are applied at a rate of 1 to 1 1⁄2 pounds of product per acre. Periodic broadcast applications of fire ant baits will provide about 90% control when properly applied. Baits can be broadcast with hand-held, vehicle-mounted or aerial applicators. The speed and duration of ant suppression varies with the product used. Hydramethylnon, fipronil, indoxacarb, metaflumazone and spinosad baits (see Baits section) provide maximum control from a few days to 4 weeks after application, while insect growth regulator (IGR) bait products (i.e., those containing methoprene or pyriproxyfen) provide maximum suppression 2 to 6 months after treatment depending on environmental conditions. Abamectin baits act more slowly than hydramethylnon, fipronil, indoxacarb, metaflumazone and spinosad but more quickly than IGR products. A late summer IGR application provides maximum suppression the following spring. Using higher rates of an IGR bait does not eliminate colonies more quickly. The blending of half rates of a faster acting bait plus a n IGR (such as hydramethylnon plus methoprene as in the product Extinguish® Plus and Amdro Fire Strike Fire Ant Bait for Broadcast Yard Treatment, or as directed on AmdroPro® and Extinguish® product labels) can provide faster and longer lasting suppression. Where there are many mounds per acre (200 or more), a second application may be needed after the maximum effects of the first treatment have occurred, because not all mounds are affected by a single bait application. Follow label instructions on any time interval requirements between applications and limits on number of applications per year.

Fig. 4. Herd GT77 Fire ant bait applicator mounted on an ATV, used for larger areas.


Fig. 5. Typical hand-held seeder used to apply fire ant bait insecticide to small areas.

2. Individual mound treatment. This method is often used in small areas (usually 1 acre or less) of ornamental turf with fewer than 20 colonies per acre where there are fewer than 20 mounds per acre. It is also useful in situations where preservation of native ants is desired. This program selectively controls fire ants, but rapid re-invasion will likely occur. This method requires more labor and monitoring than other methods and is not designed for large or heavily infested areas.

Treat undesirable fire ant mounds using an individual mound treatment insecticide (see on Individual Mound Treatments with Contact). Products are applied as dusts, dry granules, granules drenched with water after application, liquid drenches or baits. Non-chemical treatment methods such as drenching mounds with very hot water also may be used. Mound treatments may need to be repeated to eliminate the colony if queen ants are not all killed with the initial treatment. When treating an ant mound with a liquid product or watering a product into a mound, begin on the outside of the mound and circle into the center of the mound. Application of faster-acting granular ant bait formulations are made around the mound as directed.

3. The **Two-step Method basically involves the two methods described above.** These two steps are: 1) broadcasting a bait product (see the section on Baits in Fire Ant Treatment Methods), followed by 2) treating nuisance mounds with a faster acting individual mound treatment or with a mound re-treatment of the bait.

Step 1. Once or twice per year, usually in spring and fall, broadcast a bait-formulated insecticide as directed on the label. Most conventional baits are applied at a rate of 1 to 1 1⁄2 pounds of product per acre. Periodic broadcast applications of fire ant baits will provide about 90 percent control when properly applied. Baits can be broadcast with hand-held, vehicle-mounted or aerial applicators. The speed and duration of ant suppression varies with the product used. Hydramethylnon, fipronil, indoxacarb, metaflumizone and spinosad baits (see Baits section) provide maximum control from a few days to 4 weeks after application, while insect growth regulator (IGR) bait products (i.e., those containing methoprene or pyriproxyfen) provide maximum suppression 2 to 6 months after treatment depending on environmental conditions. Abamectin baits act more slowly than hydramethylnon, fipronil, indoxacarb, metaflumazone and spinosad but more quickly than IGR products. A late summer IGR application provides maximum suppression the following spring. Using higher rates of an IGR bait does not eliminate colonies more quickly. The blending of half rates of a faster acting bait plus a n IGR (such as hydramethylnon plus methoprene as in the product Extinguish® Plus and Amdro Fire Strike Fire Ant Bait for Broadcast Yard Treatment, or as directed on AmdroPro® and Extinguish® product labels) can provide faster and longer lasting suppression. Where there are many mounds per acre (200 or more), a second application may be needed after the maximum effects of the first treatment have occurred, because not all mounds are affected by a single bait application. Follow label instructions on any time

interval requirements between applications and limits on number of applications per year.

Repeat the bait application when ants re-invade the area and exceed the tolerance level for a site or mound numbers reach 20 or more per acre. Bait products will not protect against reinvasion by ant colonies or by newly mated queens from surrounding land. Ant populations can fully recover within 12 to 18 months of the last bait treatment. Low-lying, moist and flood-prone areas are more prone to re-infestation.

Step 2. Preferably, wait several days or more after broadcasting the bait, and then treat nuisance ant colonies (such as those in sensitive or high-traffic areas) using an individual mound treatment method. Otherwise, be patient and wait for the bait treatment to work. Any nuisance mounds that escaped the effects of bait treatment, and any colonies migrating into treated areas, should be treated as needed. In large areas, individual mound treatment may not be feasible and routine broadcast bait treatments alone may provide sufficient control.

4. Long-Residual Contact Insecticide Treatment Method. This method eliminates many ant species in treated areas and reduces re-invasion of treated areas as long as the contact insecticide remains effective. However, this method is more expensive, uses more insecticide, and has greater environmental impact than other methods. This approach is frequently used by commercial applicators for treating ornamental turf. Long-residual products that contain a pyrethroid usually work more rapidly. Fipronil granular products eliminate ant colonies more slowly but have longer residual effects.

Step 1. (Optional). Broadcast a bait-formulated insecticide in areas where there are many mounds (more than 20 per acre), or individually treat fire ant mounds. Wait 2 to 3 days after applying the bait before conducting the next step.

Step 2. Apply a contact insecticide with long residual activity (i.e., fipronil or a pyrethroid such as bifenthrin) to turfgrass as directed (generally every 4 to 8 weeks for pyrethroid products, or once per year using a granular fipronil product). Liquid or granular products (which are usually watered in after application) that can be evenly applied to an area are appropriate for this use. With most products, the initial surface treatment may not eliminate ants located deep in mounds, but routine re-application will eventually eliminate most colonies. Fipronil, a non-repellent contact insecticide that can be used with bait products, will eliminate ant colonies within 4 to 10 weeks of treatment, even those nesting well beneath the surface. However, ants migrating into treated areas may take more than a week to be eliminated.

Fig. 6. Boom sprayer used to apply a liquid insecticide formulation.

Specialized Fire Ant Control Needs

Vegetable Gardens. Fire ants occasionally feed on vegetable plants in home gardens. They tunnel underground into potatoes and feed on okra buds and developing pods. Most often fire ant damage to gardens will occur during hot, dry weather. Fire ants are a nuisance to gardeners during weeding and harvesting. Ants prey on some garden pests such as caterpillars, but protect or "tend" others, such as aphids, by keeping their natural enemies away. If fire ants are properly managed in the landscape surrounding the garden, it will be easier to keep ants from entering a garden.

> **Fire Ant Bait application.** Only a few fire ant baits are specifically registered for use in home gardens, including Fertilome Come and Get It (spinosad). The bait product Extinguish®, which contains methoprene, is registered for use in "cropland." Esteem® (pyriproxyfen) is another bait that is registered for use near 400+ edible food crops. Other bait products are not specifically registered for use inside home vegetable gardens, although some may be applied outside the garden's perimeter, but not inside the garden. Foraging ants from colonies both inside and outside the garden will collect the bait and take it to their colonies.
>
> **Contact insecticide applications.** Several contact insecticides are registered for use to treat general insecticide problems including ants. Some products containing carbaryl, deltamethrin, es-fenvalerate, pyrethrins, pyrethrins plus diatomaceous earth, and spinosad (Entrust, OMRI certified) are often labeled to control ants.

Fire Ant Control in Electrical Equipment and Utility Housings. Fire ants often infest

electrical equipment. They may chew on insulation, can cause short circuits, and can interfere with switching mechanisms. Air conditioners, traffic signal boxes, airport runway lighting and other devices all can be damaged. Fire ants can also nest in the metal housings that surround electrical and utility equipment. They frequently move soil into these units, which can cause corrosion, electrical short circuits, and other mechanical problems.

Step 1. Before treating any equipment, unplug the unit or turn off all electrical service. Use an individual mound treatment method with a faster-acting contact insecticide to eliminate colonies around electrical and plumbing casings and housings. Injectable aerosol products containing pyrethrins, or similar products, give rapid control. Hydramethylnon, abamectin, indoxacarb or spinosad baits applied near or on fire ant mounds provide control after about 1 week, even if the colony is located within the structure. Do not use liquid drenches, sprays, or products that may damage insulation around electrical fixtures. Treating a larger area around the electrical structure is optional, but will provide longer-term protection. Be extremely careful when applying pesticide around water systems and well heads to prevent contamination of wells and ground water. After ants are eliminated, remove debris and soil from the equipment housings to reduce the possibility of short circuits.

Step 2. To prevent ants from entering, treat the inside of equipment housings with specialty products labeled for such use, such as those containing propoxur (Rainbow® High Tech Insect Tag), permethrin (AntGuard®, Arinix®), synergized pyrethrins and silica gel (Stutton®JS 685 Powder), or dichlorvos (Hot Shot® No-Pest Strip). Some bait and bait station products also can be used inside equipment housings, but they provide little or no residual control.

After ants are removed from electrical equipment, prevent re-infestation and damage by sealing all sensitive electrical components, particularly those that are not insulated. Apply a long-residual contact insecticide around housings, making sure to avoid the electrical circuitry or components. Apply specifically labeled products to the housing or to the mounting pad.

Fire Ant Control near Surface Water. Because fire ants need water for survival, they are often found near creeks, run-off ditches, streams, rivers, ponds, lakes and other bodies of water. When surface water is unavailable, fire ants may tunnel down to the water table many feet below the ground. Every effort must be made to avoid contaminating water with pesticides. Some ant control products, such as those containing fipronil and methoprene, have specific restrictions on the label regarding their use near bodies of water. Fire ant bait products contain very small amounts of active ingredients and can be applied up to the water's edge, but not directly to the water.

To minimize the risk of pesticide runoff into waterways, apply fire ant baits when ants are actively foraging. Read the label carefully and do not apply closer to the edge of the body of water than allowed on the label. When treating individual mounds near the

water's edge or in drainage or flood-prone areas, exercise special care and use products such as acephate (Orthene®) that have relatively low toxicity to fish and apply the product according to label directions. Pyrethrins, pyrethroids and rotenone products should be avoided because of their high toxicity to fish. Do not apply surface, bait or individual mound treatments if rains are likely to occur soon after treatment. Nearly all insecticides can be toxic to aquatic organisms if applied improperly.

Fire Ant Bait Insecticides

The active ingredients found in fire ant baits fall into two major categories: toxins and insect growth regulator (IGR). Toxin-based baits are faster-acting than IGRs. In addition, one product contains both an IGR and toxicant.

Baits that contain an actual toxin are relatively slow-acting, which allows ample time for the active ingredient to become distributed to other colony members, including the queen, through trophallaxis. If a toxin acted too fast, foragers could die before returning the bait to the colony. The types of baits that kill the queen(s) as well as workers and begin demonstrating control about 2 weeks following application. Two exceptions are baits containing the active ingredient indoxacarb or metaflumizone. Indoxacarb or metaflumizone bait provides control within a few days following application. Toxin-based baits usually provide a few to several months of control. The five insecticide toxins used in these types of bait are: abamectin, fipronil, hydramethylnon, indoxacarb, and spinosad. Applicators should be aware that as formulations change and new active ingredients are developed this list may change.

Baits containing IGRs do not result in mortality of the queen(s) or adult workers; instead, they prevent the queen's production of viable eggs. The three active ingredients used in these types of baits are: fenoxycarb, s-methoprene, and pyriproxyfen. These materials act quickly to prevent new fire ants from developing, but it takes longer for the existing workers to die. Results from broadcast applications of fenoxycarb and pyriproxyfen can be seen in 6-8 weeks. S-methoprene may take 8-12 weeks. Insect growth regulators usually provide 6-12 months of control, depending upon how quickly new fire ant queens re-invade the area.

Some commercial bait formulations contain a slow acting toxin (hydramethylnon) and an IGR (s-methoprene). One advantage to this combination product is that it will provide faster control than you get with an insect growth regulator alone, yet longer-lasting control than a toxin-based bait alone. In addition, the hydramethylnon-only bait formulation and the S-methoprene-only bait formulation can be mixed together at half rates to achieve similar control if the commercial product is not available. However, check with your states recommendations as this may not be legal in all states.

Specific Bait Information

Below is a listing and brief discussion of active ingredients for the fire ant baits discussed above. Often, formulations will vary, resulting in specific trade names labeled

for very specific sites and usage. Pesticide regulations and insecticide registrations may vary from state and state. Consult your local Extension office, state pesticide board or state agriculture department to determine the registration status of specific insecticide products.

Toxin-based bait active ingredients

(hydramethylnon) - Several bait formulations containing hydramethylnon are available. The amount of hydramethylnon in the bait varies depending upon formulation. For example, one formulation marketed for homeowners using traditional fertilizer or drop spreaders contains about 1/20th of the hydramethylnon contained in other formulations and is broadcast at rates about 20 times higher than other hydramethylnon formulations. Some formulations may be applied to grass forage (pasture and rangeland) for the control of fire ants, while others are labeled for non-agriculture uses such as yards, turfgrass and recreational areas. Hydramethylnon formulations are not labeled for crop or home garden use. Control with hydramethylnon bait is achieved in about 2-4 weeks. Application rates vary with formulation and range from about 1-20 pounds per acre. Refer to product labels for specific usage details.

(fipronil) - Several ant baits are formulated with fipronil as the main active ingredient. Fire ant baits containing fipronil are not labeled for use in pastures and marketed toward professionals. This bait is relatively fast-acting product with speed of control similar to hydramethylnon. The broadcast application rates vary from 1.5 to 5 pounds per acre. Refer to product labels for specific usage details.

(metaflumizone) – A couple of fire ant baits use metaflumizone as the active ingredient. One metaflumizone bait formulation is labeled for some non-bearing nursery stock and non-agricultural uses such as golf courses, lawns, recreational areas, school grounds and other non-ag uses. The other formulation is labeled for citrus orchards, tree nut orchards, grape vineyards and non-bearing nursery stock. Bait containing metaflumizone cannot be used in vegetable gardens, cropland or pastures. The broadcast application rate is from 1 to 1.5 pounds per acre. Currently, baits containing metaflumizone or indoxacarb are the fastest-acting and provide 90% or better control within about 3 days. Fire ant foraging is suppressed from within 12-24 hours.

(indoxacarb) – Currently, one fire ant bait formulation uses indoxacarb as the active ingredient. This formulation is labeled for use on recreational areas, golf courses and other noncrop/ nongrazed areas such as home residential lawns. Bait containing indoxacarb cannot be used in vegetable gardens, cropland or pastures. The broadcast application rate is 1.5 pounds per acre. Currently, baits containing indoxacarb or metaflumizone are the fastest-acting and provide 90% or better control within about 3 days. Fire ant foraging is suppressed from within 12-24 hours.

(spinosad) - Several fire ant bait formulations contain spinosad as the active ingredient. These products are considered all natural or “organic”. Spinosid baits are relatively fast-acting (similar to hydramethylnon), but may be inconsistent when broadcasted. The

labels indicate that these specific baits can be used in organic gardens that are less than one acre. Broadcast application rates vary from about 2.5 to 5 pounds per acre. Refer to product labels for specific usage details.

(abamectin) - Some fire ant bait formulations contain abamectin as the active ingredient. Spinosad is the natural fermentation product of the soil bacterium *Streptomyces avermitilis*. Although spinosad is a naturally-derived active ingredient, OMRI certified formulations are not currently available. At least two abamectin formulations are available; one for professional applicators to apply in turfgrass, residential areas, recreational areas and other non-crop areas and one for agricultural use in specific crops such as almonds, citrus, some nuts and grapes. Abamectin baits are not labeled for use on pastures, cropland or home gardens. The broadcast application rate is 1 pound per acre. Abamectin baits are slow-acting for toxin-based baits. Although abamectin is not a true an IGR, it performs like an IGR when broadcasted. Control is achieved quicker when applied to individual mounds. It usually takes longer than 1 month to achieve control when broadcasted. Refer to product labels for specific usage details.

Baits with insect growth regulators

(s-methoprene) – One fire ant bait formulation contains s-methoprene as the active ingredient. S-methoprene, like other IGR baits, prevents the production of viable eggs but do not kill adult ants. Baits containing s-methoprene have a very broad site-use label and can be used on pastures, cropland and turfgrass areas including home yards, recreational areas and other non-crop areas. The broadcast application rate varies from 1 to 1.5 pounds per acre. S-methoprene bait is one of the more slower-acting IGR baits and will provide control within 2-3 months if applied in spring. If applied in the fall it will provide control within 4- 8 months of application. One application per year is usually sufficient but this will depend on reinvasion pressure. Refer to product labels for specific usage details.

(pyriproxyfen) – Two bait formulations contain the IGR, pyriproxyfen as the active ingredient. One formulation is labeled for use in hay fields, pastures and some horticultural crops such as vegetables, fruit trees, berries and nuts. The other formulation is labeled for use in non-crop turf and ornamental sites such as home yards recreation areas and landscape areas. The broadcast application rate for pyriproxyfen baits ranges from 1.5 to 2 pounds per acre. Pyriproxyfen bait, being an IGR, is relatively slow. Control is apparent within 1-3 months if applied in spring and 3-6 months if applied in the fall. Refer to product labels for specific usage details.

(fenoxycarb) – Fenoxycarb, an IGR, is the active ingredient found in at least one fire ant bait formulation. Fenoxycarb bait formulations are labeled for use in nonbearing crops; urban, residential and commercial areas; and turf and ornamental usage such as yards recreational areas and other non-crop area. Fenoxycarb bait is not labeled for use in pastures, crops or home gardens. The broadcast application rate for fenoxycarb bait ranges for 1 to 1.5 pounds per acre. Baits containing fenoxycarb are slow-acting with

speed of activity similar to pyriproxyfen. Refer to product labels for specific usage details.

Combination (toxins and IGRs) baits

(s-methoprene + hydramethylnon) – Two fire ant bait formulations contain a combination of s-methoprene and hydramethylnon as active ingredients. The amount of s-methoprene and hydramethylnon in the bait varies depending upon formulation. For example, one formulation marketed for homeowners using traditional fertilizer or drop spreaders, contains about 1/20th of the s-methprene and hydramethylnon contained in other formulations and is broadcast at rates about 20 times higher than the other s-methoprene and hydramethylnon combination bait formulation. The agriculture formulation may be applied to grass forage (pasture and rangeland) for the control of fire ants, while the non-agriculture formulation is labeled for non-agriculture uses such as yards, turfgrass and recreational areas. S-methoprene and hydramethylnon combination bait formulations are not labeled for crop or home garden use. The broadcast application rate, for the combination bait formulations, range from 1.5 to 20 pounds per acre. Control with s-methoprene and hydramethylnon combination bait is achieved in about 2-4 weeks. This combination provides the speed of hydramethylnon and the duration of control of s-methoprene. Refer to product labels for specific usage details.

Contact Insecticides

(botanicals (d-limonene, pyrethrins, rotenone, pine oil, cedar oil, turpentine)) - The citrus or orange oil component, d-limonene, is a cytotoxin that kills cells after entering the insect body through direct contact. Other essential oils or components of essential oils have come on the market in the last few years in a variety of pesticides. Essential oils are volatile, highly concentrated substances extracted from plant parts, including the oils of cedar, cinnamon, citronella, citrus, clove, eugenol (a component of clove oil), garlic, mints, rosemary, and several others. As insecticides, they vary in their modes of action, but most work as contact killing agents only, so re-treatment may be needed. Some are promoted as repellents. Some essential oils used as pesticides may work by disrupting an insect neurotransmitter that is reported to be not present in people, pets, or other vertebrates. Most of these ingredients are generally regarded as safe for mammals by the United States Food and Drug Administration when used as directed. Many are even used extensively as flavorings and scents in foods, cosmetics, soaps, and perfumes. Pyrethrum is the source of natural insecticides made from the ground dried flowers of certain species of a chrysanthemum plant. The ground flowers contain a mixture of several different compounds called pyrethrins and cinerins. Pyrethrins are natural insecticidal compounds that are extracts of the chrysanthemum plant. Pyrethroid insecticides, such as permethrin, bifenthrin, cypermethrin and others, are synthetic versions of this naturally occurring insecticide. Pyrethrins, like pyrethroid insecticides, bind to sodium channels that occur along the length of nerve cells. Sodium channels are responsible for nerve signal transmission along the length of the nerve cell by permitting

the flux of sodium ions. When pyrethrins bind to sodium channels, normal function of the channels is obstructed thereby resulting in overexitation of the nerve cell and, consequently, a loss of function of the nerve cell. Pyrethrins are often combined with diatomaceous earth (see inorganic compounds below). Rotenone acts on respiratory tissues, nerves and muscles. Pyrethrins and rotenone products break down rapidly in the environment. Rotenone, cedar oil and pine oil (turpentine) products are relatively slow-acting (days to weeks) and are applied as mound drenches.

(derivatives of pyrethrins (allethrin, resmethrin, sumithrin, tetramethrin)) - Like pyrethrins, these products destabilize nerve cell membranes and kill quickly, but are quickly deactivated and have little residual activity. They are contact insecticides applied as aerosol injections, mound drenches or surface sprays.

(pyrethroids (bifenthrin, cyfluthrin, cypermethrin, deltamethrin, fenvalerate, fluvalinate, lambda-cyhalothrin, permethrin, s-bioallethrin, es-fenvalerate, tefluthrin, tralomethrin)) - These products also destabilize nerve cell membranes. They can persist in the environment longer than pyrethrins and their derivatives. They kill ants relatively quickly and are applied as mound drenches, dusts, surface sprays or granules.

(carbamates (carbaryl)) - These materials disrupt nerve transmission (cholinesterase inhibitor). They are relatively quick-killing contact insecticides used as mound drenches, soil treatments and surface sprays.

(organophosphates (acephate)) - These products also interfere with nerve cell transmission (cholinesterase inhibitor). They are relatively quick-killing and are formulated as aerosols, liquids, dusts or granules. They can be applied as mound treatments or surface treatment.

(spinosyns (spinosad)) - Spinosad, which includes spinosyn A and spinosyn D, is derived through the fermentation of a naturally occurring organism. These insecticides have a unique mode of action that is different from all other known insect control products. Spinosad causes excitation of the insect nervous system, leading to involuntary muscle contractions, prostration with tremors, and finally paralysis. These nerve toxin effects are consistent with the activation of nicotinic acetylcholine receptors by a mechanism that is novel and unique among known insecticidal compounds. Several of the spinosad liquid products have fire ant mound drench instructions on label.

(phenyl pyrazole (fipronil)) - As a nervous system toxicant, fipronil blocks the passage of chlorine ions by interacting with gamma-aminobuteric acid (GABA)-gated chloride channels on nerve cell membranes. Granular formulations are broadcast on turfgrass areas and control ants about 4 to 8 weeks after application. Control continues for up to a year. Examples: (Topchoice® Insecticide, Taurus®G Insecticide Granules, both RESTRICTED USE products for purchase and use only by licensed pesticide personnel)

Biological Control

Currently, the best biological control method for fire ants is to preserve other ant species that compete with them for food and nesting sites, attack small fire ant colonies, or kill newly mated queen ants. In some areas, outbreaks of other exotic ant species, such as Argentine ants and tawny crazy ants, have displaced imported fire ants. Even imported fire ants from single-queen or polygyne colonies will prey upon newly mated fire ant queens and eliminate small, neighboring colonies. Ants, in general, are considered beneficial insects because they prey upon many other arthropods and collectively till more earth than earthworms, thereby reducing soil compaction. Ways to preserve native ants include preserving their habitat and using insecticides judiciously.

Introducing or conserving the natural enemies (diseases, parasites and predators) of imported fire ants can help control them. Natural enemies kill fire ants or make them less able to compete with other ant species. The most effective biological control organisms for large-scale programs are those that spread by themselves from mound to mound and persist from year to year. Several species of parasitic “phorid” flies (Diptera: Phoridae), including *Pseudacteon tricuspis, P. curvatus, P. obtusus and P. litoralis*, have been released and established in parts of the southeastern states. A fire ant disease, *Kneallhazia* (=*Thelohania*) *solenopsae*, is also widespread in some states. Although natural enemies will not eliminate fire ants and it may be several years before their effect is fully known, most researchers suggest that introducing natural enemies of fire ants in the U.S. will reduce their populations indefinitely. In South America, where imported fire ants and their natural enemies originate, fire ant species much less abundant and not usually considered pest.

Newly mated fire ant queens, which can start new colonies, are killed by a number of organisms. These include birds, lizards, spiders, toads, dragonflies, robber flies, other ant species, and ants from surrounding colonies. Animals that eat ants, such as armadillos, may disturb mounds and eat some workers, but they are not really useful in control.

Cultural Control

Cultural control of imported fire ants is limited. However, use of physical barriers, habitat modification and tillage can reduce some of the problems associated with fire ants.

Physical barriers are used to prevent fire ants from moving onto objects or into specific areas. For example, Teflon® tape applied to an object will prevent ants from climbing up the object. Likewise, talcum powder results in the same effect. However, both lose effectiveness in moist or humid conditions thus frequent re-application may be required. Tanglefoot® (a sticky material that is either painted or sprayed on an object) is another effective barrier that ants and other arthropods will adhere to when attempting to walk on the Tanglefoot®. Frequent reapplication is required, especially during dusty conditions.

Habitat modification and sanitation. Fire ants need ample moisture, sunlight and food to thrive. Practices that limit these necessities can reduce the problems associated with fire ants and in some cases reduce fire ant density. Fire ants rarely build colonies in heavily wooden areas instead they colonize open areas with ample sunlight (several hours per day). Practices such as planting shade trees that limit the amount and duration of sunlight can reduce fire ant density. Limiting water in temperate regions is not feasible or possible. However, in more arid regions where fire ants have established in association with irrigated areas, limiting irrigation in non-agriculture areas may reduce fire ant density.
Good sanitation in frequently used areas can reduce human contact with fire ants that are foraging for an easy food source. For example, garbage and other food sources should not be stored and/or should be promptly removed from patio area, pavilions and other human-use training or recreational areas.

Tillage. Shallow disking and dragging a heavy object such as a railroad tie will reduce mound height for several weeks to months but used alone are unlikely to reduce ant or colony numbers. In areas infested with multiple queen colonies, dragging may cause the colonies to split into more but smaller colonies. Reduced mound height will be temporary unless followed up by an insecticide application. Dragging and disking is sometimes used in hay pastures to minimize problems associated with mowing and hay harvest and provide benefit when tall mounds persist after ant colonies are eliminated in areas where grasses and other vegetation have grown into mounds.

Regulatory Control

Imported fire ants are spread through natural mating flights and through the transport of infested sod, baled hay, soil (alone and with other material), nursery stock, other potted or balled plants and used earthmoving equipment. The rate of spread through natural mating flights is relatively slow in comparison to transport through these human-aided means. Because fire ants are easily transported in nursery stock and soil, the United States Department of Agriculture's Animal and Plant Health Inspection Service (USDA-APHIS) developed a quarantine program for this pest in the 1950s. This program was enacted as the Federal Imported Fire Ant Quarantine (7CFR301) regulation to slow and minimize the artificial spread of imported fire ants from fire ant infested (quarantined) areas to non-infested (non-quarantined) areas.

Inspections and enforcement are often carried out by state departments of agriculture. To prevent the spread of imported fire ants, regulated items such as soil, potted plants, nursery stock, grass sod, earthmoving equipment and baled hay and straw may not be moved from quarantined to non-quarantined areas unless accompanied by a document that certifies certain procedures have been met to ensure that these items are free from imported fire ants. Fire ants must be eliminated from regulated articles that will be transported, which requires treatments differ from the management type treatments described in this plan. Managers should also know that grass sod, nursery stock and other regulated equipment may be moved from a quarantined area to another

quarantined area or from a non-quarantined area to a quarantined area without inspections or certificates.

Additional information regarding the Federal Imported Fire Ant Quarantine is available at http://www.aphis.usda.gov/planthealth/pests_and_diseases then select “Imported Fire Ants” under category “Insects”.

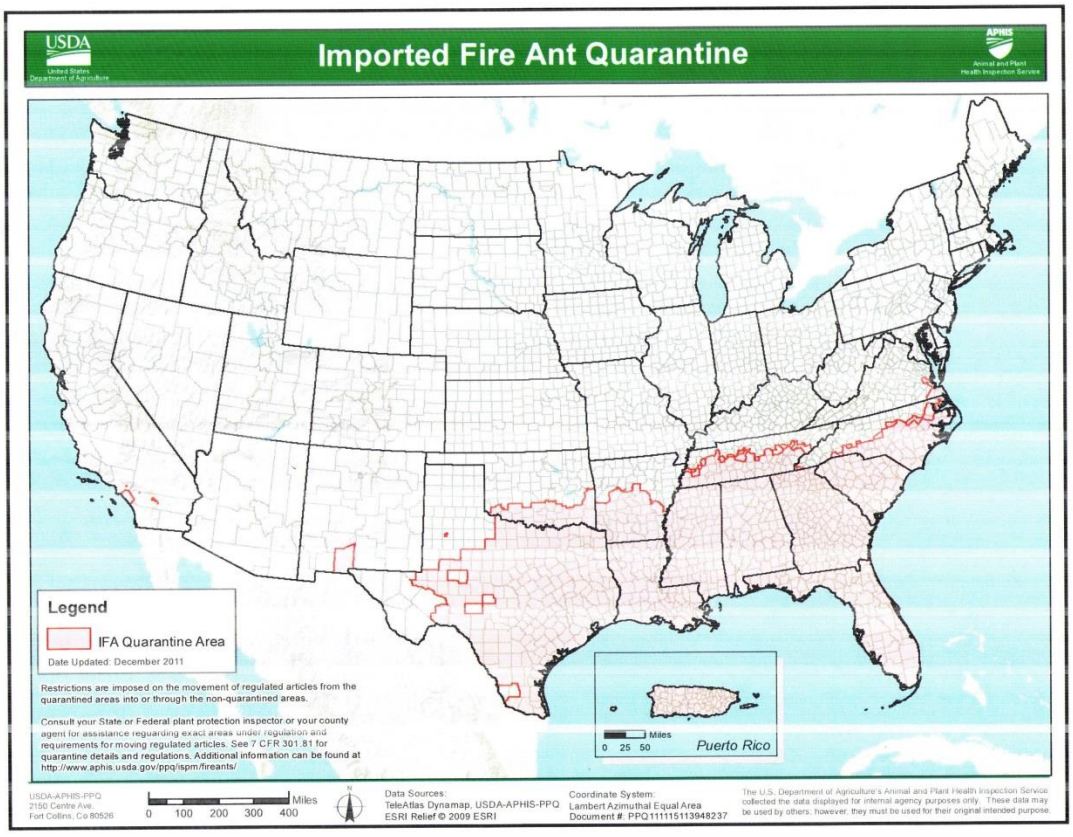

Fig. 7. Map of current (as of Jan. 2015) imported fire ant quarantine area.

References Cited

Camilo, G.R. and S. A. Phillips Jr. 1990. Evolution of ant communities in response to invasion by the fire ant, *Solenopsis invicata* Pp. 190-198 in Applied myrecology: A world perspective. Ed. R.K. Vander Meer, J. Jaffe and A. Cedeno. Westview studies in insect biology. Boulder, Colorado: Westview Press.

Giulliano, W.C., C.R. Allen, R.S. Lutz, and S. Demarais. 1996. Effects of red imported fire ants on northern bobwhite chicks. Journal Wildlife Management 60:309-313.

Hook, A.W. and S.D. Porter. 1990. Destruction of harvester ant colonies by invading fire ants in south-central Texas (Hymentoptera:Formicidae). Southwest Naturalist 35: 477-478.

Lard, C.F., J. Schmidt, B. Morris, L. Estes, C. Ryan and D. Bergquist. 2006. An economic analysis of imported fire ants in the United States of America. Texas Ag. Experiment Station Report. 22 pp.

Stimac, J.L. and S.B. Alves. 1994. Ecology and biological control of fire ants. Pp. 353-380 in Pest management in the subtropics: Biological control-A Florida perspective. Ed. D. Rosen, F.D. Bennett, and J.L. Capinera. Andover, U.K. Intercept Limited.

Taber, S.W. 2000. Fire Ants. Texas A & M University Press. College Station, Texas. 308 pages.

Some of the information presented in this document was adapted from*: Managing Imported Fire Ants in Urban Areas*, Authors: Bastiaan “Bart” M. Drees, S. Bradleigh Vinson, Roger E. Gold, Michael E. Merchant, Elizabeth “Wizzie” Brown, Kim Engler, Molly Keck, Paul Nester, David Kostroun, Kathy Flanders, Fudd Graham, Dale Pollet, Linda Hooper-Bui, Patricia Beckley, Tim Davis, Paul M. “Mac” Horton, Wayne Gardner, Kelly Loftin, John Hopkins, Karen Vail, Russell Wright, Wayne Smith, David C. Thompson, John Kabashima, Blake Layton, Phil Koehler, Peter B. Schultz, David Oi and Anne-Marie Callcott